EE630 Summer 07
Take Home Final Exam

Exam Policies: open book, no correspondence or communication about exam to anyone except instructor

Problem 1 – Biological Genetics (5 pts)

What experiment could we conduct to tell if a tall pea plant was heterozygous or homozygous ?

Problem 2 – Canonical Genetic Algorithms / Schema Theorem (15 pts)

Five individuals in a canonical genetic algorithm are:

01101
11010
01110
11100
01111

In the encoding scheme used, 00000 represents x=-5 and 11111 represents x=10. The fitness function is $f(x) = (x-1)^2$. Ignoring mutation and crossover, what is the expected number of times the schema **10* will appear in the next generation?

Problem 3 – Real Coded Genetic Algorithms (10 pts)

Consider a real coded genetic algorithm. The gene values of two parents are 0.6 and 0.9. Generate the value for the children using simulated binary crossover with $\eta_c = 2$, and supposing that the random number u is 0.75. Include the effects of gene-repair, if needed.

Problem 4 – Single Objective Optimization with GOSET (20 pts)

On the course web site is data in the form frequency f, magnitude (not in db) m, and phase (in radians) p. This transfer function has the form

$$T(s) = \frac{K\omega_n^2}{s^2 + 2\omega_n \delta s + \omega_n^2}$$

where $s = j2\pi f$. Use GOSET to identify ω_n, δ, and K.

see next page for more

Problem 5 – Multi Objective Optimization (10 pts)

Consider the points in objective function space

Point	(f_1, f_2)
A	(2, 5)
B	(1, 8)
C	(2, 9)
D	(2.5, 4.7)
E	(2.8, 1.0)
F	(1.5, 0.2)
G	(5.6, 9.3)
H	(4.7, 6.3)
I	(9.2, 4.5)
J	(2.7, 8.8)

It is desired to maximize f_1 and minimize f_2. Name the non-dominated points.

Problem 6 – Multi Objective Optimization (10 pts)

Consider the point in problem 5 in the context of an elitist non-dominated sorting GA. Determine the crowding distance for each point on the first front. You do not need to find the crowding distance of the two points defining the endpoints of the front.

Problem 7 – Multi Objective Optimization (GOSET) (15 pts)

Compute the Pareto-Optimal front for

$$\min\ f_1(x_1, x_2) = x_1$$

$$\min\ f_2(x_1, x_2) = (1+10x_2)\left[1-\left(\frac{x_1}{1+10x_2}\right)^2 - \frac{x_1}{1+10x_2}\sin(8\pi x_1)\right]$$

$$0 < x_i < 1,\ i = 1, 2$$

Problem 8 – Multi Objective Optimization (GOSET) (15 pts)

Compute the Pareto-Optimal front for

$$\min\ f_1(x_1, x_2, x_3) = -10\exp\left(-0.2\sqrt{x_1^2 + x_2^2}\right) - 10\exp\left(-0.2\sqrt{x_2^2 + x_3^2}\right)$$

$$\min\ f_2(x_1, x_2, x_3) = |x_1|^{0.8} + |x_2|^{0.8} + |x_3|^{0.8} + 5\sin(x_1^3) + 5\sin(x_2^3) + 5\sin(x_3^3)$$

$$-5 < x_i < 5,\ i = 1, 2, 3$$